



# Carnation

## Wastewater Treatment Plant Appendix D - River Discharge Technical Information

City of Carnation, Washington/  
King County Department of Natural Resources and Parks

**WASTEWATER TREATMENT PLANT OUTFALL STUDY**

**TECHNICAL MEMORANDUM 12 – OUTFALL EVALUATION**

May 2003



City of Carnation, Washington/  
King County Department of Natural Resources and Parks

Wastewater Treatment Plant Outfall Study

Technical Memorandum 12 – Outfall Evaluation

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## **TECHNICAL MEMORANDUM 12 – OUTFALL EVALUATION**

### **1.0 INTRODUCTION**

The City of Carnation (Carnation) began a facility planning process in 1999 to evaluate the collection and treatment of the City's domestic wastewater. As a part of that facility planning process, Cosmopolitan Engineering Group (Cosmopolitan) evaluated a potential discharge of wastewater treatment plant effluent into the Snoqualmie River. Cosmopolitan's report established siting and design criteria for an outfall into the river, evaluated dilution factors at the boundaries of potential acute and chronic mixing zones, and evaluated potential water quality-based effluent limitations.

King County Department of Natural Resources and Parks is leading a new facilities planning study of Carnation's domestic wastewater treatment needs. The study will establish design flows and loadings, evaluate wastewater treatment options, evaluate discharge options including river and upland discharges, and will include environmental assessments and public involvement.

This technical memorandum presents the results of evaluating three different outfall locations with direct discharge to the Snoqualmie River, the benefits and requirements of a discharge to an oxbow lake, and a discharge to a constructed wetlands. The evaluations consider the site's geomorphology, suitability of the location for an outfall, dilution modeling results, a Total Maximum Daily Load (TMDL) study for the Snoqualmie River, and potential technology-based, water quality-based, TMDL-based, and Water Reclamation and Reuse Standards-based permit limitations. The evaluations do not consider the wastewater treatment plant (WWTP) discharge's compatibility with public recreation or salmon spawning and rearing in the Snoqualmie River.

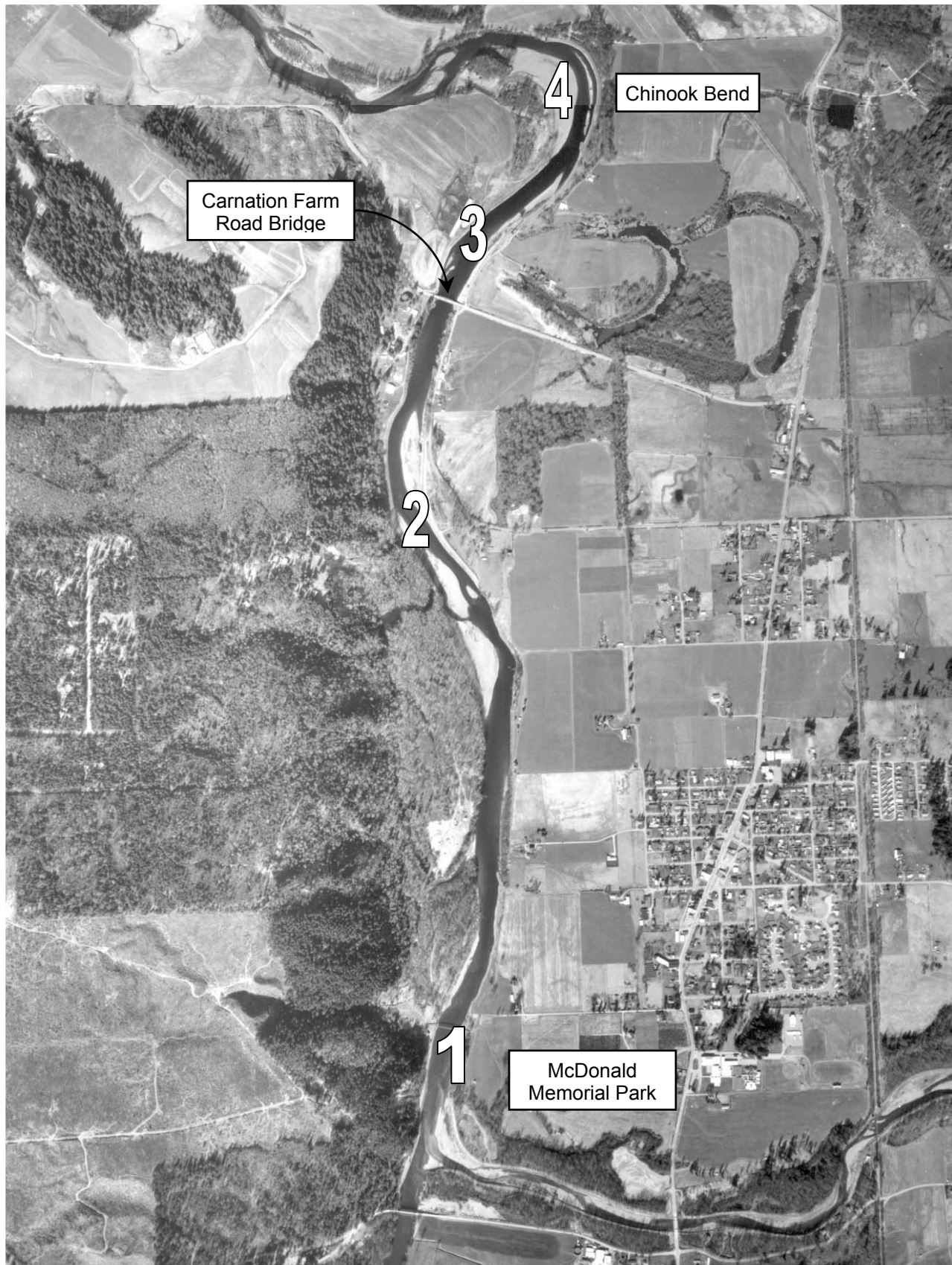
### **2.0 LOCATIONS CONSIDERED FOR A WWTP OUTFALL**

#### **2.1 Desirable Conditions for a River Outfall Location**

Locating an outfall into a river requires consideration of the river channel's stability. River channels can shift location and have exposed WWTP outfalls in the former channels. This eliminates the benefits of mixing, exposes the outfall to public contact, and increases aesthetic concern. Floods may also deposit river sediment over the end of outfalls, which reduces hydraulic capacity and dilution capability.

A desirable river discharge location will have a historically stable channel. Other desirable outfall locations characteristics include manmade structures, such as bridges, and river bends, especially with a riprapped outside bank.

Figures 1, 2, 3, and 4 are aerial photographs, spanning the years 1985 through 2002, of the reach of the Snoqualmie River being evaluated for possible outfall locations. In addition to these photographs, aerial photographs for years prior to 1985 and as far back as the year 1938 were also examined. The purpose of this review is to assess the historical channel stability in various reaches.



**Figure 1: Aerial Photograph:  
March 9, 1985**

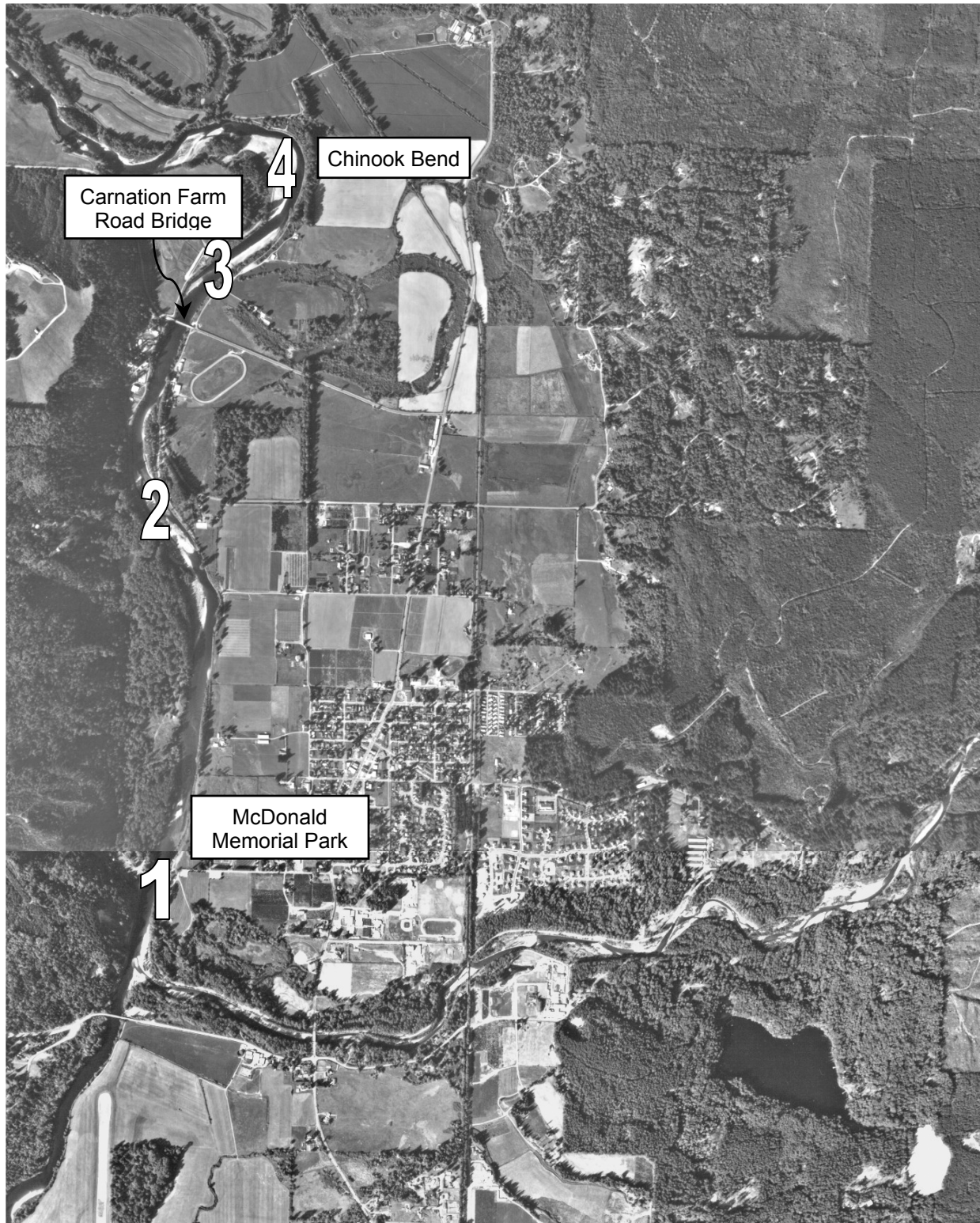
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**Figure 2: Aerial Photograph:  
August 12, 1990**

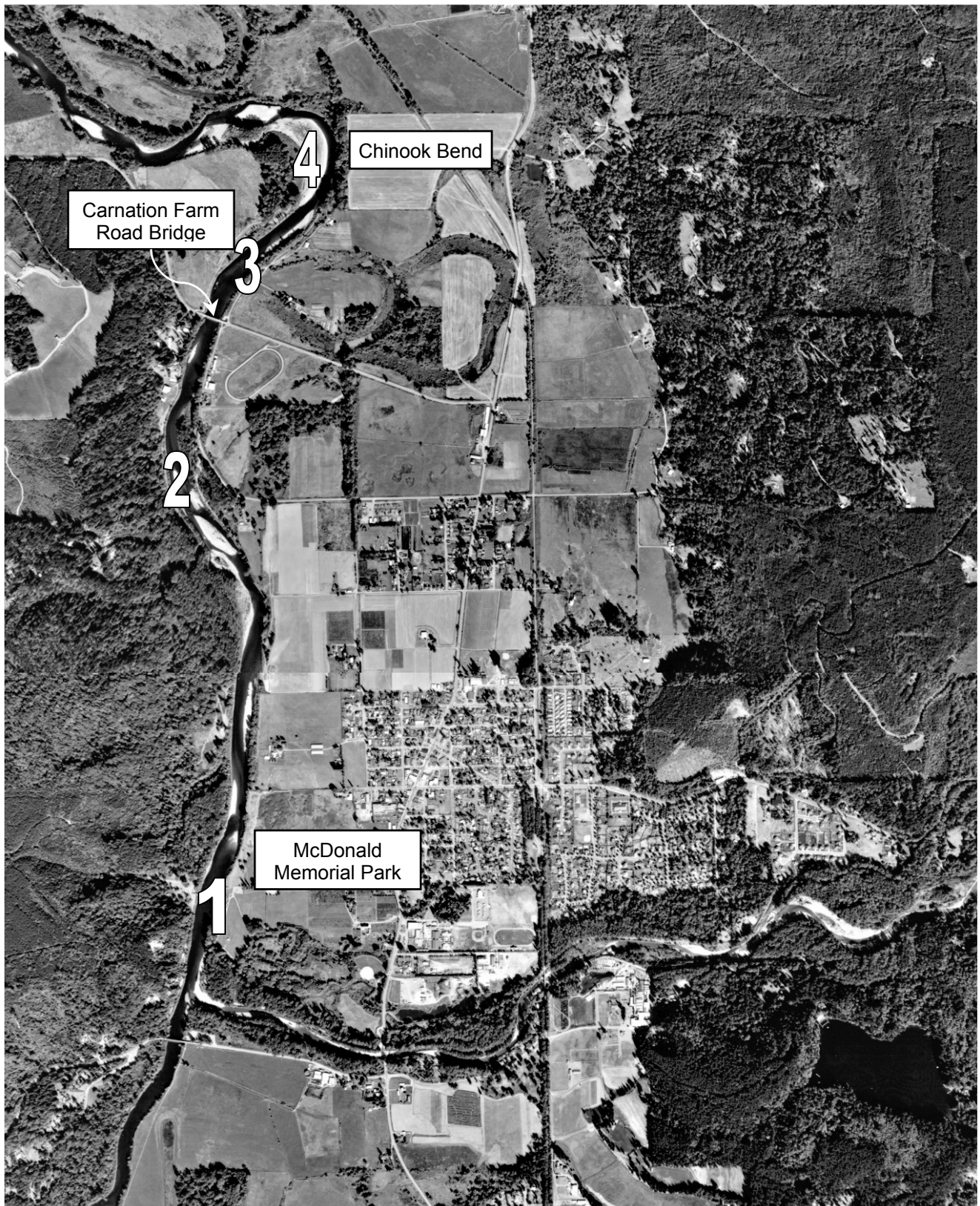




**Figure 3: Aerial Photograph:  
September 22, 1995**

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**Figure 4: Aerial Photograph:  
September 23, 2002**

June 3, 2003

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Several areas of the Snoqualmie River in the vicinity of Carnation will not support an outfall. These areas are identified in the aerial photographs by gravel bars and stream channels that have changed over time. Areas deemed unsuitable for siting an outfall are identified numerically on the aerial maps (Figures 1 through 4) and delineated on the location map (Figure 5). Descriptions of the unsuitable areas follow:

1. Upstream of McDonald Memorial Park, the right bank has irregular and shifting gravel bars that would damage and/or periodically bury an outfall discharge.
2. Gravel bars, an unsuitable condition for an outfall location, have formed on the right bank approximately one-half of the way between McDonald Memorial Park to Chinook Bend
3. The reach upstream of the Carnation Farm Road Bridge has had numerous transient gravel bar formations
4. The left bank, or inside bend, of Chinook Bend consists of a significant gravel bar

The earlier photographs show a gravel bar near the right bank of Chinook Bend. Aerial photographs from 1980 show this bar eroding and the main channel shifting towards the outside of the bend. Photographs taken after 1990 show no evidence of this bar and the main channel has shifted to the outside of the bend. This area has remained stable since the 1990 photographs and will be considered for one of the outfall locations.

## **2.2 Locations Considered for a WWTP Outfall**

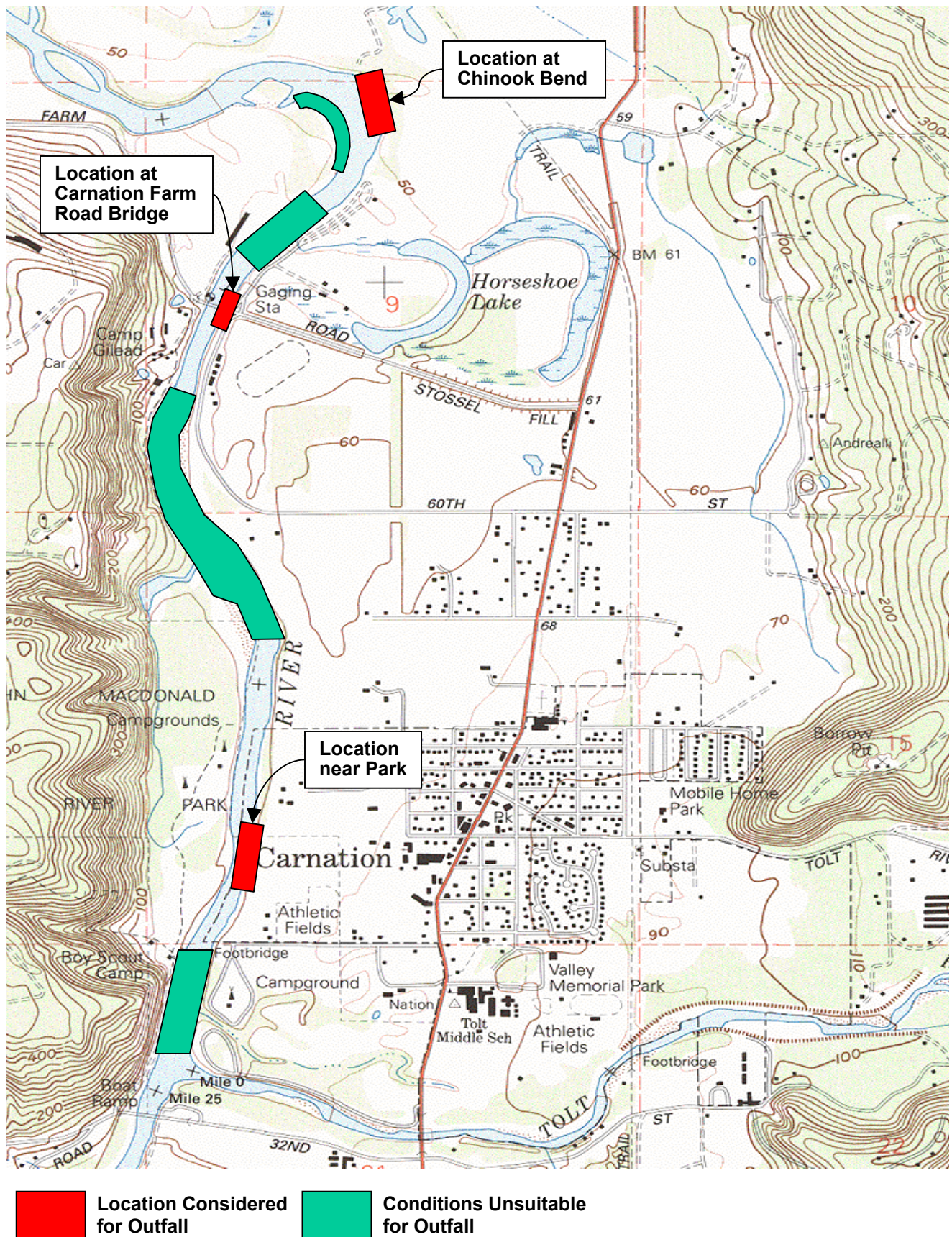
Based on the desirable characteristics for an outfall location, three river areas near Carnation meet the stability concerns for locating an outfall. Descriptions of the three areas follow. In addition to identifying unsuitable areas, Figure 5 also identifies the areas considered for an outfall.

### **2.2.1 Snoqualmie River near McDonald Memorial Park**

Carnation owns a parcel of land near McDonald Memorial Park that is being considered as one of the potential sites for the WWTP. The parcel is located a few hundred feet east of the Snoqualmie River. The river in this area, near River Mile (RM) 24, has a wide bed with a steep, riprapped right bank. The left side of the river in this area is gravelly with some cobbles and sandy banks. The photographs in Figure 6, and the photographs of the other locations, were taken on March 20, 2003. At the time the photographs were taken, the river flow rate was approximately 3400 cubic feet per second (cfs).

The river in the vicinity of McDonald Memorial Park has a slight bend and a deeper channel at the right. A review of historical aerial photographs indicates this area of the river has been stable with no braiding or main channel movement. If an outfall was located in this area or any of the other considered river sites, the discharge pipe, either open-ended or with a diffuser, would probably be anchored at the toe of the bank and extend 10 to 20 feet into the channel at an approximate 45-degree downstream angle.





**Figure 5: Location Map**

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### **2.2.2 Snoqualmie River near McDonald Memorial Park**

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### **2.2.3 Snoqualmie River at Carnation Farm Road Bridge**

The Carnation Farm Road Bridge is located between RM 22 and 23. The river is fairly wide, and based on observations and historical aerial photographs, the flow is dispersed throughout the entire river width. Significant features of this location include footings and piers of the Carnation Farm Road Bridge near both banks. The remnants of a previous bridge, four concrete footings and piers, remain in the river slightly upstream of the existing bridge. One of the piers on the east bank has toppled into the river. Also at this location, the United States Geologic Survey (USGS) operates a gaging station, No. 12149000, located on the river's west bank. Figure 7 depicts this area.

### **2.2.4 Snoqualmie River at Chinook Bend**

Chinook Bend, slightly downstream of RM 22, forms a 90-degree bend where the river flow direction changes from north to west (Figure 8). The right bank is riprapped, which helps to stabilize the bank and channel location. Outside bends in rivers are desirable locations for outfall structures because these areas are typically stable and have deeper channels than other areas of the river. Several suitable outfall sites exist on the right bank of the river along this reach.

### **2.2.5 Oxbow Lake**

The Snoqualmie River Valley has numerous pond areas, termed oxbows, that were at one time a part of the main river channel. The oxbows were formed by the avulsion of river bends. As time passed, the oxbows became isolated from the river as the river-proximal end filled with sediment. The oxbow exists as a lake, pond, or wetlands with a tie creek between it and the river, until the oxbow eventually fills with sediment and eventually transitions to meadow. Because the river migration rate is generally low, most oxbows that now exist were formed prior to the earliest mapping done about the year 1870 (Collins and Sheikh, 2002).





*View upstream*



*View across river*



*View downstream*

**Figure 6: Snoqualmie River Near McDonald Memorial Park**





*View north of bridge on east bank*



*View south of bridge on east bank*



*View north side of bridge on east bank*



*View south side of bridge on west bank,  
old bridge pier on right side*



*View north side of bridge on west bank*

**Figure 7: Snoqualmie River at Carnation Farm Road Bridge**





*View downstream from west shoreline at mid-bend*



*View upstream from west shoreline at mid-bend*



*View across river from west shoreline at downstream end of bend*

**Figure 8: Snoqualmie River at Chinook Bend**